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### **ABSTRACT**

A financial crisis with a capital flow reversal occurs when a country shifts abruptly from a “good” equilibrium with a low country-specific risk premium to a “bad” equilibrium with a high country-specific risk premium and no foreign credit.

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# COUNTRY RISK AND CAPITAL FLOW REVERSALS

by: Assaf Razin<sup>1</sup> and Efraim Sadka<sup>2</sup>

## Abstract

A financial crisis with a capital flow reversal occurs when a country shifts abruptly from a “good” equilibrium with a low country-specific risk premium to a “bad” equilibrium with a high country-specific risk premium and no foreign credit.

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Keywords: country risk, capital flow reversals.

## 1 Introduction

A remarkable feature of the 1997 crisis of the emerging economies in South and South-East Asia is the lack of early warning of the traditional sorts, such as budget deficits, external debts, slow capital formation, etc. Accordingly, the credit ratings of these economies were relatively sound. Nonetheless, the crises erupted.

In this paper we offer a channel through which such crises can erupt. We employ a model of credits with defaults, due to Townsend (1979). This model was later extended to macroeconomics by Bernanke and Gertler (1989). We employ it to derive a sort of multiple equilibria phenomena with self-fulfilling beliefs: One equilibrium with a steady inflow of capital, sound macroeconomic variables and a high credit rating; and another, “bad” equilibrium with dried-up capital inflows, doomed growth prospects and poor credit rating.

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## 2 Analytical Framework

Consider a two-period model of a small, open economy. Suppose for simplicity that capital imports are channelled solely through firms borrowing in the world capital markets. (The amount of direct retail credit is typically negligible.) As the economy is small, suppose initially that it faces a perfectly elastic supply of credit for **safe projects** at a given risk-free world rate of interest- ( $r^*$ ). The actual rate for any given firm will, of course, be higher depending on the riskiness of its investment plans, as we shall specify later. In a subsequent section we will introduce also an element of country risk.

Suppose there is a continuum of *ex-ante* identical domestic firms.<sup>3</sup> Each firm employs capital input ( $K$ ) in the first period in order to produce a single composite good in the second period. We assume that capital depreciates at the rate  $\delta$ . Output in the second period is equal to  $F(K)(1 + \varepsilon)$ , where  $F(\cdot)$  is a production function exhibiting diminishing marginal productivity of capital and  $\varepsilon$  is a random productivity factor with zero mean and is independent across all firms.  $\varepsilon$  is bounded from below by -1, so that output is always nonnegative. It is also assumed that it is bounded from above, say by one. We assume that  $\varepsilon$  is purely idiosyncratic, so that there is no aggregate uncertainty. For each  $\varepsilon$ , there will be exactly  $N\Phi(\varepsilon)$  firms whose output in the second period will be below or equal to  $F(K)(1 + \varepsilon)$ , where  $\Phi(\cdot)$  is the cummulation distribution function of  $\varepsilon$  and  $N$  is the number of firms. But in the first period no one knows who these firms are. Thus, each firm faces a probability of  $\Phi(\varepsilon)$  of having an output below or equal to  $F(K)(1 + \varepsilon)$  in the second period. Upon proper portfolio diversification, consumers-savers behave in a risk-neutral way. To simplify the notation we normalize the number of firms to one, that is:  $N = 1$ .

Investment decisions are made by the firms before the state of the world (that is,  $\varepsilon$ ) is known. Since all firms face the same probability distribution of  $\varepsilon$ , they all choose the same level of investment. They then seek loan funds to finance the investment, either at home or abroad. Denote the gross investment of the firm by  $I$ . Therefore, if its initial stock of capital in the first period, carried over from the preceding period is  $K_0(1 - \delta)$ , then the stock of capital which the firm employs in the first period is  $K = K_0(1 - \delta) + I$  where  $\delta$  is

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<sup>3</sup>This formulation of the risk in the economy follows Gordon and Bovenberg (1996).

the rate of depreciation.

Since credit is extended *ex-ante*, before  $\varepsilon$  is revealed, firms cannot sign default-free loan contracts with the lenders. We therefore consider loan contracts which allow for the possibility of default. We adopt the “costly state verification” framework à la Townsend [see Townsend (1979) and Bernanke and Gertler (1989)] in assuming that lenders make firm-specific loans, charging an interest rate of  $r^j$  to firm  $j$ . The interest and principal payment commitment will be honored when the firm encounters a relatively good productivity shock, and defaulted when it encounters a relatively bad shock. The loan contract is therefore characterized by a loan rate ( $r^j$ ), with possible default, and a threshold value ( $\bar{\varepsilon}^j$ ) of the productivity parameter, defined as follows:

$$F(K^j)(1 + \bar{\varepsilon}^j) + (1 - \delta)K^j = [K^j - (1 - \delta)K_0^j] (1 + r^j), \quad (1)$$

and

$$\begin{aligned} & [1 - \Phi(\bar{\varepsilon}^j)] [K^j - (1 - \delta)K_0^j] (1 + r^j) \\ & + \Phi(\bar{\varepsilon}^j)(1 - \mu)\{F(K^j) [1 + e^-(\bar{\varepsilon}^j)] + (1 - \delta)K^j\} \\ & = [K^j - (1 - \delta)K_0^j] (1 + r^*), \end{aligned} \quad (2)$$

Equation (1) defines the value of the productivity shock for which the funds available to the firm just suffice to repay the principal of and the interest on the loan. These funds consist of the output of the firm, plus the depreciated stock of capital. This is the expression on the left-hand side of (1). When the realized value of  $\varepsilon^j$  is larger than  $\bar{\varepsilon}^j$ , the firm is solvent and will thus pay the lenders the promised amount, consisting of the principal  $K^j - (1 - \delta)K_0^j$ , plus the interest  $r^j [K^j - (1 - \delta)K_0^j]$ , as given by the right-hand side of (1). If, however,  $\varepsilon^j$  is smaller than  $\bar{\varepsilon}^j$ , the firm will default. In the case of default, the lenders incur a cost in order to verify the true value of  $\varepsilon^j$  and to seize the residual value of the firm. This cost, interpretable as the cost of bankruptcy, is assumed to be proportional to the amount

seized,  $[F(K^j)(1 + \varepsilon^j) + (1 - \delta)K^j]$ , where  $0 < \mu \leq 1$  is the factor of proportionality. Net of this cost, the lenders will receive  $(1 - \mu)[F(K^j)(1 + \varepsilon^j) + (1 - \delta)K^j]$ . The expected rate of return required by foreign lenders who are the marginal lenders in this capital-importing economy is  $r^*$ . Therefore, the “default” rate of interest,  $r^j$ , must offer a premium over and above the default-free rate,  $r^*$ , according to (2). The first term on the left-hand side of (2) is the contracted principal and interest payment, weighted by the no-default probability. The second term measures the amount seized by the creditors, net of the cost of bankruptcy, and weighted by the default probability where  $e^-(\bar{\varepsilon}^j) = E(\varepsilon/\varepsilon \leq \bar{\varepsilon}^j)$  is the mean value of  $\varepsilon$  realized by the low-productivity firms. The expression on the right-hand side of (2) is the no-default return required by foreign creditors.

Observe that (1) and (2) together imply that:

$$[1 - \Phi(\bar{\varepsilon}^j)] + \frac{\Phi(\bar{\varepsilon}^j)(1 - \mu)\{F(K^j)[1 + e^-(\bar{\varepsilon}^j)] + (1 - \delta)K^j\}}{(1 - \alpha^j)F(K^j)(1 + \bar{\varepsilon}^j) + (1 - \delta)K^j} = \frac{1 + r^*}{1 + r^j}. \quad (3)$$

Since  $\varepsilon^-(\bar{\varepsilon}^j) < \bar{\varepsilon}^j$  and  $0 < \mu \leq 1$ , it follows that  $r^j > r^*$ , the difference being a default premium (which depends, among other things, on  $K^j$ ,  $\bar{\varepsilon}^j$  and  $\mu$ ).

The firm in this setup is competitive (that is, a price-taker) only with respect to  $r^*$ , the international risk-free rate of return. This  $r^*$  cannot be influenced by the firm’s actions. However,  $r^j$ ,  $K^j$  and  $\bar{\varepsilon}^j$  are firm-specific and must satisfy equations (1) and (2). In making its investment (that is,  $K^j - (1 - \delta)K_0^j$ ) and its financing (loan contract) decisions, the firm takes these constraints into account. Since these decisions are made before  $\varepsilon$  is known, that is, when all firms are (*ex ante*) identical, they all make the same decision. Therefore, we henceforth drop the superscript  $j$ .

Consider now the investment-financing decision of the firm. Its objective is to maximize its net expected discounted value for its shareholders. Since consumers in this economy compete with foreign lenders in providing credits to the firms, they must, at equilibrium, earn the same rate of return as foreigners, namely,  $r^*$ . Hence, the net expected discounted value of the firm to its shareholders is:

$$(1 + r^*)^{-1} [1 - \Phi(\bar{\varepsilon})] \{ F(K)[1 + e^+(\bar{\varepsilon})] + (1 - \delta)K - [K - (1 - \delta)K_0](1 + r) \}, \quad (4)$$

where  $e^+(\bar{\varepsilon}) = E(\varepsilon/\varepsilon \geq \bar{\varepsilon})$  is the mean value of  $\varepsilon$  for the “high” productivity firms. Note that the firm has a positive value only in the no-default states, that is, only when  $\varepsilon \geq \bar{\varepsilon}$  and it fully repays the principal of and the interest ( $r$ ) on the loan. The firm chooses  $K$ ,  $\bar{\varepsilon}$  and  $r$  so as to maximize (4), subject to (1) and (2). Substituting (1) into the other constraint (2) and into the objective function (4), we can eliminate the firm-specific interest rate  $r$  and the optimization problem of the firm reduces to:

$$Max_{\{K, \bar{\varepsilon}\}} \{ (1 + r^*)^{-1} [1 - \Phi(\bar{\varepsilon})] F(K) [e^+(\bar{\varepsilon}) - \bar{\varepsilon}] \}, \quad (5)$$

subject to:

$$\begin{aligned} & [1 - \Phi(\bar{\varepsilon})] [F(K)(1 + \bar{\varepsilon}) + (1 - \delta)K] \\ & + \Phi(\bar{\varepsilon})(1 - \mu) \{ F(K)[1 + e^-(\bar{\varepsilon})] + (1 - \delta)K \} - [K - (1 - \delta)K_0](1 + r^*) \geq 0. \end{aligned} \quad (6)$$

A solution of this problem defines an equal investment level for each firm ( $I = K - (1 - \delta)K_0$ ) and an equal firm-specific interest rate ( $r$ ) and an equal default threshold ( $\bar{\varepsilon}$ ). Note that  $NI = I$  is also the total credit taken by all firms. The excess of this amount over national saving comprises the capital imports.

Note from either (4) or (5) that if a firm sets  $\bar{\varepsilon} = 1$ , then its net expected discounted value is zero. (Because in this case the firm will always default.) If the firm does not invest at all, then its net expected discounted value is  $(1 + r^*)^{-1} \{ F[K_0(1 - \delta)] + K_0(1 - \delta)^2 \}$  which is positive. Therefore, it always pays the firm to set a threshold level  $\bar{\varepsilon}$  that would leave a positive probability of no default.

Note also that if the world rate of interest ( $r^*$ ) is sufficiently high, then the firm will abstain from taking loans and making investments. This is because the firm-specific

interest rate ( $r$ ) must always include a default premium over  $r^*$ ; see equation (3). But at a sufficiently large interest on its loan, the firm will default in all states of nature (that is, values of  $\varepsilon$ ). This would contradict our earlier conclusion that it does not pay the firm to default in all states of nature. A formal proof is provided in the appendix.

### 3 Country Risk

We have assumed so far that there is a fixed world rate of interest ( $r^*$ ) at which foreign lenders are willing to extend credit to the domestic firms in the small economy. In reality, there are varieties of world rates facing firms in different countries, depending on each country's credit rating. The credit rating is **external** to our (ex-ante) identical firms, and depends on some aggregate (macro) economic variables or political factors.

Suppose, for instance, that the country's credit rating depends positively on its aggregate investment. Interpret now  $r^*$  as a basic interest rate (e.g., *libor*) and let  $\pi$  be a country-specific risk premium, so that firms borrow at  $r^* + \pi$ , where  $\pi$  is external to each individual firm. This  $\pi$  depends negatively on aggregate investment  $NI = I$ . That is, the more that a country invests (and the rosier look its growth prospects), the lower is the interest rate ( $r^* + \pi$ ) it pays on its credits.

Formally, the analysis now follows the same lines of the preceding section, except that  $r^* + \pi$  replaces  $r^*$ . It is important to emphasize that although  $\pi$  depends on  $NI = I$ , this dependence is external to the firm. That is, when choosing  $I = K - (1 - \delta)K_0$ , the firm takes  $\pi$  as exogenously given in the same way that it views  $r^*$  as exogenous.

We turn now to the discussion of the equilibria in this case. Suppose that the equilibrium described in the preceding section involves a "high" level of aggregate investment. Then, the country-specific risk premium introduced here would be "very small" (that is, the country gets a "flying colors" credit rating). Hence, the equilibrium will not change much now, and the country-specific risk premium would be hardly observable. This is referred to as a "good" equilibrium.

However, there may be another, "bad" equilibrium with a very high  $\pi$ , no investment



and no foreign credit. (We have seen in the preceding section that if the world rate of interest is sufficiently large, investment is drawn down to zero). Thus, a country may switch abruptly from the “good” equilibrium to the “bad” equilibrium, as its creditors may somehow, for reasons unexplained in the model, shift their beliefs about the country’s credit worthiness. These new beliefs (that the country is at high credit risk) are self-fulfilling: Indeed, the country’s investments dry out.

## 4 APPENDIX

From equation (1) we note that:

$$1 + r \leq \frac{F(K)(1 + 1) + (1 - \delta)K}{K - (1 - \delta)K_0}, \quad (\text{A.1})$$

because  $\bar{\varepsilon} \leq 1$ . Hence:

$$1 + r \leq \frac{2[F(K)/K] + (1 - \delta)}{1 - (1 - \delta)\frac{K_0}{K}} \equiv M(K). \quad (\text{A.2})$$

Since the average product of capital is assumed diminishing, it follows that:

$$\lim_{K \rightarrow \infty} M(K) < 2\{F[K_0(1 - \delta)]/K_0(1 - \delta)\} + (1 - \delta).$$

Also,

$$\lim_{K \rightarrow K_0(1 - \delta)} M(K) = 2\{F[K_0(1 - \delta)]/K_0(1 - \delta)\} + (1 - \delta).$$

Thus, there is an upper bound on the firm-specific interest rate ( $r$ ) for which condition (1) can hold.

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